AF

Patent
Attorney Docket No. 1003301-000162

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of	**MAIL STOP APPEAL BRIEF - PATENTS**
Mehdi Aram	
Application No.: 10/501,267	Group Art Unit: 1762
Filed: July 9, 2004	Examiner: Katherine A. Bareford
For: THERMAL SPRAYING OF A PISTON RING	Appeal No.: ______________

APPEAL TRANSMITTAL LETTER

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Enclosed is an Appeal Brief for the above-identified patent application.

☐ A Petition for Extension of Time is enclosed.

☐ Also enclosed is/are: ______________

☐ Small entity status is hereby claimed.

☐ Charge ______________ to Deposit Account No. 02-4800 for the fee due.

☐ A check in the amount of ______________ is enclosed for the fee due.

☒ Charge $500.00 to credit card for the fee due. Form PTO-2038 is attached.

☒ The Director is hereby authorized to charge any appropriate fees under 37 C.F.R. §§ 1.16, 1.17 and 1.20(d) and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 02-4800. This paper is submitted in duplicate.

Respectfully submitted,

BUCHANAN INGERSOLL & ROONEY PC

Date July 26, 2007

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For: THERMAL SPRAYING OF A PISTON RING	)	Confirmation No.: 7478

APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This appeal is from the decision of the Primary Examiner dated December 19, 2006, finally rejecting claims 1-5, 7-13 and 26-28. These claims are reproduced as the Claims Appendix of this brief.

The Commissioner is hereby authorized to charge any appropriate fees under 37 C.F.R. §§1.16, 1.17, and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 02-4800.

I. Real Party in Interest

The present application is assigned to Koncentra Holding AB, which is the real party in interest.

II. Related Appeals and Interferences

Appellant's legal representative, or assignee, does not know of any other appeal or interferences, which will affect or be directly affected by, or have bearing on, the Board's decision in the pending appeal.

III. Status of Claims

Claims 1-5, 7-13 and 26-28 are pending in this application. Claims 6, 14-25, 29 and 30 were cancelled. Claims 1-5, 7-13 and 26-28 were finally rejected in the Office Action dated December 19, 2006, and are being appealed.

IV. Status of Amendments

No Amendment was filed subsequent to mailing of the final Office Action.

V. Summary of Claimed Subject Matter

Claims 1-5, 7-13 and 26-28 are directed to a method of applying a wear resistant coating material to a surface of a piston ring. Claim 1 is the sole independent claim.

Claim 1 recites a method of applying a wear resistant coating material to a surface (22) of a piston ring (1) (page 10, ll. 5-8; Figure 4). The method comprises

the steps of applying the coating material by a thermal spray process (page 8, ll. 22-28), heat treating the coating material at an elevated temperature and for a time effective to at least partially diffuse the coating material into the underlying surface (col. 6, ll. 9-14), by exposing the material to heating temperature below the melting point of the coating material (page 10, ll. 5-18), and applying additional coating material layers (24) subject to successive heat treatments of each said applied coating material layer (24) in order to lay down on the piston ring surface (22) a plurality of layers (24) of same said coating material (page 4, ll. 6-19; page 9, ll. 1-27), wherein the resulting piston ring coating including the plurality of applied layers (24) has a porosity of between 1 to 15 vol% (page 5, ll. 14-18).

VI. Grounds of Rejection to be Reviewed on Appeal

1. The rejection of claims 1, 4, 5, 7-9 and 11-13 under 35 U.S.C. § 103(a) over U.S. Patent No. 4,024,617 to McCormick in view of U.S. Patent No. 3,066,042 to Ogden, JP 2000-017418 and U.S. Patent No. 3,617,349 to Prasse.

2. The rejection of claims 2, 3, 10 and 26-28 under 35 U.S.C. § 103(a) over U.S. Patent No. 4,024,617 to McCormick, U.S. Patent No. 3,066,042 to Ogden, JP 2000-017418 and U.S. Patent No. 3,617,349 to Prasse, and further in view of U.S. Patent No. 5,713,129 to Rastegar et al.

VII. Argument

A. Principles of Law

The Office has the initial burden of establishing a factual basis to support the legal conclusion of obviousness. *See In re Oetiker*, 977 F.2d 1443, 1445, 24

USPQ2d 1443, 1444 (Fed. Cir. 1992); *In re Piasecki*, 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir. 1984). The Office must make the factual determinations set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 17, 148 USPQ 459, 467 (1966). These factual determinations include: 1) the scope and content of the prior art; 2) the differences between the prior art and the claims at issue; 3) the level of ordinary skill in the art; and 4) any relevant secondary considerations, including commercial success, long felt but unsolved needs, and failure of others.

For rejections under 35 U.S.C. § 103(a) based upon a combination of prior art references, the Supreme Court stated that "a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *KSR Int'l v. Teleflex Inc.*, 127 S.Ct. 1727, 1741, 82 USPQ2d 1385, 1396 (2007). The Office must also provide articulated reasoning with rational underpinnings to support the alleged obviousness of the claimed subject matter. As stated in *In re Kahn*, 441 F.3d 977, 988, 78 USPQ2d 1329, 1336 (Fed. Cir. 2006), "rejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *See also In re Fine*, 837 F.2d 1071, 1073, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988).

Where it is alleged that claim limitations are found in a combination of prior art references, it must be determined "[w]hat the prior art teaches, <u>whether it teaches away from the claimed invention</u>, and whether it motivates a combination of teachings from different references" (emphasis added). *Dystar Textilfarben GMBH & Co. Deutschland KG v. C.H. Patrick Co.*, 464 F.3d 1356, 1367, 80 USPQ2d 1641,

1645 (Fed. Cir. 2006). "A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant." *In re Gurley*, 27 F.3d 551, 553, 31 USPQ2d 1130, 1131 (Fed. Cir. 1994), *See also In re Caldwell*, 319 F.2d 254, 256, 138 USPQ 243, 245 (CCPA 1963) (a reference teaches away if it leaves the impression that a product would not have the property sought by applicant). "[W]hen prior art teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious." *KSR* at 127 S.Ct. 1740, 82 USPQ2d 1395.

Only if the Office meets its initial burden does the burden of coming forward with evidence or argument shift to the Appellant. *Oetiker*, 977 F.2d at 1445, 24 USPQ2d at 1444; *Piasecki*, 745 F.2d at 1472, 223 USPQ at 788.

B. Rejection Under 35 U.S.C. § 103(a) Over U.S. Patent No. 4,024,617 to McCormick in View of U.S. Patent No. 3,066,042 to Ogden, JP 200-017418 and U.S. Patent No. 3,617,349 to Prasse

1. Claims 1, 4, 8, 9, 12 and 13

a. Claimed Subject Matter

The method of applying a wear resistant coating material to a surface of a piston ring recited in claim 1 comprises the steps of applying the coating material by a thermal spray process, heat treating the coating material at an elevated temperature and for a time effective to at least partially diffuse the coating material into the underlying surface, by exposing the material to heating temperature below the melting point of the coating material. The method comprises applying additional coating material layers subject to successive heat treatments of each applied coating

material layer in order to lay down on the piston ring surface a plurality of layers of the <u>same</u> coating material. The resulting piston ring coating including the plurality of applied layers (24) has a porosity of between 1 to 15 vol%.

The claimed method produces a <u>piston ring</u> comprising a <u>porous, multi-layer</u> coating that is strongly bonded to a surface of the piston ring. Internally strong bonds are formed to the piston ring surface <u>and</u> also within the coating layers. These strong bonds are formed by controlling the heating conditions that each of the plurality of layers of the coating material is exposed to after being applied on the piston ring. The coating material of each layer is exposed to a temperature below the melting point of the coating material. Specification at page 4, ll. 20-28. This heating is conducted for a period of time effective to cause the coating material to at least partially diffuse into the underlying surface. This heating results in a multi-layer coating containing pores located between particles of the coating and the coating having a porosity of 1 to 15 volume%. Specification at page 5, ll. 1-2.

b. <u>References Applied in Rejection</u>

1. <u>U.S. Patent No. 4,024,617 ("McCormick")</u>

McCormick discloses a method of applying a single-layer refractory coating to a metal substrate. The substrate can be a sealing element, such as a piston ring, packing ring, or other seal. Col. 1, ll. 6-11. Figure 3 shows a substrate 26 with a coating 27 diffusion bonded to the substrate 26. Col. 3, ll. 59-61. The coating can be applied by plasma jet flame, an electric arc, or any oxy-acetylene flame. Col. 4, ll. 14-16. The coated substrate is subjected to heating. Col. 4, ll. 39-60. McCormick discloses that piston rings are <u>distorted</u> by extended exposure to high temperatures, e.g., of about 1700°F (about 925°C). Col. 2, ll. 5-8. McCormick discloses that power

is applied to an induction coil for very short periods of time and is pulsed on and off to effect heating of the applied coating 27. Col. 4, ll. 55-55.

McCormick further discloses that a diffusing element or constituent can be contained in the principal coating (col. 4, ll. 65-67), or it can be separately applied as an intermediate coating, layer or facing (i.e., a coating, layer or facing applied between the substrate and outer layer). Col. 4, l. 67 to col. 5, l. 1. A <u>different</u> face coating material (i.e., different coating composition) is applied on the intermediate coating, resulting in the two-layer coatings consisting of layers composed of different materials from each other.

McCormick does <u>not</u> disclose that the single-layer coatings, or the two-layer coatings comprised of different coating materials, have a particular volume percentage of porosity. McCormick discloses that piston seal facings having a "high degree of porosity" may not be diffusion bonded directly without an intermediate layer of nickel or chrome using an oxy-acetylene flame. Col. 8, ll. 40-43. McCormick also discloses that "more porous coatings" may bond directly by diffusion at the temperature of the flame application process "<u>if</u> an <u>intermediate layer</u> of high-strength material such as ni-chrome is used (Example no. IV)" (emphasis added). Col. 8, ll. 44-47. McCormick does not define the meaning of the phrases "high degree of porosity" or "more porous coatings."

McCormick does not disclose a method of applying <u>a porous, multi-layer coating</u> on <u>any</u> substrate.

2. <u>U.S. Patent No. 3,066,042 ("Ogden")</u>

Ogden discloses a method of coating a refractory metal with a platinum-group metal. Col. 1, ll. 38-46. Ogden does not disclose that the coating is applied on a

piston ring. Ogden's method comprises spraying a platinum-group metal on a refractory metal to form a first coating; shot peening the first coating, heat treating the shot-peened first coating; spraying the platinum-group metal on the first coating to form a second coating; shot peening the second coating; heat treating the shot-peened second coating; and repeating the spraying, shot peening and heat treating steps to form additional coatings over the second coating. Col. 1, ll. 47-71. The shot peening step is performed to plastically deform each of the separate coatings, so that the "entire layer is substantially plastically deformed sufficiently to condition the layer for improved solid diffusion of the layer by a subsequent heat treating" (emphasis added). Col. 2, ll. 15-20.

Ogden discloses that porous sprayed layer coatings do not adequately protect the underlying material. Col. 1, ll. 34-37. Ogden's heat treating step (annealing) is performed at a temperature of 600°C to 1400°C (1,112°C to 2,552°F) for an extended period of one to ten hours, whereby solid diffusion of the layer eliminates pores in the sprayed coatings. Col. 2, ll. 22-28. In the Example, Ogden discloses that "the layer was found to be substantially non-porous." Col. 2, ll. 47-62. Ogden further discloses that the coating "completely covers the body." Col. 1, ll. 42-43.

Ogden does not disclose applying a multi-layer coating having the claimed porosity on any substrate.

3. JP 2000-017418 ("JP '418")

The English-language Abstract and computer translation of JP '418 disclose a method of applying a coating made of "white metal" on a surface of a bearing base by thermal spraying. The as-sprayed coating layer has a porosity of 20% or less. Paragraph [0010]. The coating is subjected to a diffusion heat treatment in a furnace. The heat treatment reduces the level of porosity in the coating to 10% or less. Abstract and paragraph [0010]. JP '418 discloses that "bearing parts with few defects, such as pore, can be obtained in the coating layer of white metal" (emphasis added). *See, e.g.,* paragraphs [0011] and [0019].

JP '418 does not disclose applying a coating with more than one layer of coating material on any substrate.

4. U.S. Patent No. 3,617,349 ("Prasse")

Prasse discloses a method of making antifriction piston rings. Prasse's method comprises applying a single-layer coating of a hard porous metal or metal alloy on a surface of a piston ring, heating the coated piston ring in an oven to drive air from the pores, and impregnating the pores of the coating with a solid antifriction agent, which remains in the pores when the liquid carrier is evaporated from the pores by heating. Abstract; col. 2, ll. 52-72; col. 4, ll. 19-27 and col. 7, ll. 8-9. The coating layer has a porosity of 7% to 30% by volume of the outer surface of the thus-coated bearing face. Col. 2, ll. 63-66.

Prasse does not disclose applying a coating with multiple coating layers on any substrate.

c. The Office Has Not Established a *Prima Facie* Case of Obviousness for the Claimed Subject Matter as a Whole

Appellant submits that the Office has not articulated a reason with rational underpinnings to combine McCormick, Ogden, JP '418 and Prasse in a manner to result in the method recited in claim 1. To the contrary, this combination of references would have led one skilled in the art away from the claimed method. The Office has also not established a factual basis to show that one skilled in the art would have known how to effect the proposed combination, or that this combination of references would have yielded predictable results.

McCormick does not disclose the final porosity of the single-layer coating, much less suggest that any certain level of porosity in the coating is desirable for any reason. McCormick does not disclose or suggest forming a multi-layer coating comprising a plurality of layers of the same coating material on a substrate, much less such a coating having a porosity of 1 to 15 volume% on a piston ring.

Ogden is unrelated to piston rings and the problems they encounter during operation, and thus provides no reason to modify McCormick's single-layer coating process to form a multi-layer coating with the claimed amount of porosity on a piston ring. Ogden also does not disclose how to form such a multi-layer coating. Even assuming that one skilled in the art would have considered Ogden's teachings, Ogden would have led one having ordinary skill in the art away from modifying McCormick's single-layer coating to result in the claimed piston ring comprising a multi-layer coating having the claimed porosity.

Ogden is directed specifically to forming coatings on molybdenum substrates, but is unrelated to forming coatings on piston rings. Moreover, Ogden discloses forming only substantially non-porous coatings on the molybdenum substrates. To achieve this object, Ogden's heat treating step is performed at a high temperature for

an extended period of time to eliminate existing pores in each layer of the coatings, to thereby produce a multi-layer coating structure that is substantially non-porous. Ogden discloses that porous coatings do not protect the underlying substrate. In stark contrast, the method recited in claim 1 comprises heating each layer of the applied coating material to produce a strongly-bonded, multi-layer coating structure having the claimed porosity level that is effective to protect the piston ring.

Ogden further discloses that each coating layer is plastically deformed to obtain the desired solid diffusion of the layer by the subsequent heat treatment and obtain the desired mechanical and metallurgical bond to the substrate. This plastic deformation would be expected to reduce the porosity in the coating layers prior to the heat treatment. The Office appears to have taken the position that Ogden discloses that any multi-layer coating would produce a stronger mechanical and metallurgical bond. However, Ogden does not support this position. For example, Ogden does not disclose that a suitably strong bond can be formed to the substrate without plastically deforming each coating layer, and then heating each layer at a high temperature for an extended period of time to eliminate pores in the coating layers. In the claimed process, however, each successive coating layer is sprayed onto an as-formed underlying layer without first plastically deforming the underlying layer, and strong bonds are formed with the piston ring surface and between the layers by the heating.

The Office has failed to give proper consideration to the explicit teachings in Ogden that porosity needs to be substantially totally eliminated in the multi-layer coating structure in order to completely cover the substrate and achieve a strong bond to the substrate. However, "[w]hen prior art teaches away from combining

certain known elements, discovery of a successful means of combining them is more likely to be nonobvious." *KSR*, 127 S.Ct. at 1740, 82 USPQ2d at 1395. Ogden teaches away from the claimed method by leaving the impression that a multi-layered coating that has been formed without plastically deforming each of the individual layers and without heating the layers at a high temperature for an extended period of time to substantially eliminate all pores in the layers would not provide sufficient coverage of, or sufficient bonding to, a substrate. *In re Caldwell*, 319 F.2d at 256, 138 USPQ at 245. Accordingly, forming a multi-layer coating structure having strong substrate/coating and coating layer/coating layer bonds by performing the method of claim 1, which does not include a plastic deformation step or require high-temperature annealing for an extended period of time, would have been unobvious in light of Ogden.

The Office has also not given proper consideration to the explicit disclosure in Ogden that the heat treatment should be performed at a high temperature of 600°C to 1400°C for a period of one to ten hours for each layer, while McCormick discloses that piston rings are distorted by extended exposure to high temperatures of about 925°C, which falls within Ogden's heat treatment temperature range. Additionally, Ogden discloses that the heat treatment time is dependent on the temperature that is used, i.e., lower annealing temperatures would require longer annealing times. Accordingly, Ogden teaches that a heat treatment performed in the temperature range up to somewhere below 925°C requires an extended heating time at such temperatures for each layer to achieve substantial elimination of pores. The total heat treatment time required for heat treating multiple applied layers would be substantial.

In light of the substantially different coating processes, resulting coating structures and intended applications of the coatings disclosed by McCormick and Ogden, one skilled in the art would have been led in a direction divergent to the path taken by the present inventor, i.e., to a coating substantially free of pores. Accordingly, Ogden teaches away from the claimed method for this additional reason. *In re Gurley*, 27 F.3d at 553, 31 USPQ2d at 1131.

JP '418 also does not provide a reason to modify McCormick's single-layer coating process to form a porous, multi-layer coating on a substrate, much less on a piston ring. The JP '418 process is also designed to eliminate porosity in the coating. JP '418 explicitly discloses that pores are defects, i.e., they are undesirable, in the coating layer of a bearing part. JP '418 discloses a heat treatment process that involves subjecting the part including the single-layer coating to an extended heat treatment in a furnace to eliminate these defects. In stark contrast to the JP '418 method, the method recited in claim 1 comprises heating the coating material of each coating layer to result in a multi-layer coating structure having the claimed porosity level, which provides desirable properties to the piston ring. JP '418 would have led one skilled in the art in a direction divergent to the path taken by inventor.

The Office states that JP '418 was cited "as to the specific expectations as to how each heat treating diffusion process would work with a coating applied to bearing surfaces" (emphasis added). Final Office Action at page 9, ll. 17-19. However, the Office has not established that for a multi-layer coating process, wherein each layer is subjected to the JP '418 heat treatment, the resulting multi-layer coating would reasonably be expected to have a certain volume percentage of porosity after performing the JP '418 heat treatment multiple times.

Assuming, *arguendo*, that multiple coating layers are applied on a substrate, and each applied layer is subjected to the "porosity reducing treatment" disclosed by JP '418 after it has been applied, each time that an additional coating layer is applied and heat treated using the JP '418 heat treatment (which is performed in a furnace for an extended period of time), each coating layer underlying that additional layer would also be heat treated another time. JP '418 discloses that increasing the heat treatment time at a given heat treatment temperature increases the percentage decrease in porosity for a coating layer. Particularly, at paragraphs [0048] and [0049], JP '418 discloses that the porosity of a coating layer was reduced from 3% to 1.0% (i.e., 3-1.0/3 = 67%) by heating a coating at a temperature of 200°C for 36 hours. At paragraphs [0052] and [0053], JP '418 discloses that the porosity of a coating layer was reduced from 7% to 1.5% (i.e., 7-1.5/7 = 79%) by heating the coating at a temperature of 200°C for 45 hours Based on these test results, the porosity of each of the underlying coating layer(s) would be <u>expected</u> to be further reduced <u>each time</u> that the JP '418 heat treatment is performed following the application of an additional coating layer.

By way of example, for a five-layer coating structure in which each successively applied layer is subjected to an x-hour heat treatment (JP '418 discloses that "x" can vary from 0.5 to 50 hours in the Abstract), the first applied layer would be subjected to a heat treatment for a total of 5x hours, the second applied layer (formed on the first applied layer) for a total of 4x hours, the third applied layer (formed on the second applied layer) for a total of 3x hours, the fourth applied layer (formed on the third applied layer) for a total of 2x hours, the fifth applied layer (formed on the fourth applied layer) for x hours. Because <u>each</u> layer of such multi-

layer structure would be subjected to the JP '418 heat treatment (and thus to pore elimination) for a <u>different</u> amount of time than the other layers, the Office has provided no factual basis to support the allegation that the resulting multi-layered structure would have any particular porosity level. The Office has also failed to establish that the claimed porosity level would be desirable in a multi-layer coating or that the claimed multi-layer coating would even be obtainable.

Prasse does not suggest applying a multi-layer coating on any substrate. Thus, Prasse does not suggest applying a <u>multi-layer coating</u> having the claimed porosity on a piston ring.

In the absence of any disclosure in the applied references of any component comprising a multi-layer coating having the claimed porosity, much less of any disclosure of how such a multi-layer coating can be formed, the rejection appears to be based on the position that combining the teachings of McCormick, Ogden, JP '418 and Prasse would nonetheless "inherently" result in the wear resistant coating recited in claim 1. Appellant disagrees. It is well established that "[i]nherency ... may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient." *In re Robertson*, 169 F.3d 743, 745, 49 USPQ2d 1949, 1951 (Fed. Cir. 1999) (citations omitted). The Office has not established that the claimed multi-layer coating, <u>in particular</u>, would <u>necessarily</u> result from combining the teachings of McCormick, Ogden, JP '418 and Prasse. For example, the Office has <u>not</u> shown that the methods of Ogden and JP '418 are identical or substantially identical to the method recited in claim 1 (in fact, they are substantially different and both designed specifically to eliminate "undesirable" porosity in coatings), and thus the Office has not established a factual

basis to support the allegation that the combined teachings of the references would necessarily result in any particular coating structure. For example, the Office has not established the necessary result of applying the JP '418 porosity-reducing heat treatment multiple times to a multi-layer coating. As the Office has not established a *prima facie* case based on inherency, the rejection is instead based on improper speculation. *In re Warner*, 379 F.2d 1011, 1017, 154 USPQ 173, 178 (CCPA 1967).

Thus, the applied references do not support the alleged *prima facie* case of obviousness of claims 1, 4, 8, 9, 12 and 13, for at least these reasons. Therefore, the Board is respectfully requested to reverse the rejection of these claims.

2. Claim 5

Claim 5 depends from claim 1 and recites that the resulting piston ring coating has an evenly distributed porosity. The evenly distributed pores are desirable because they provide uniform structure and uniform properties to the multi-layer coating.

Regarding claim 5, the Office took the position that "[a]s to the evenly distributed porosity, this would be an inherent result of applying the thin layers and have the porosity reducing treatment of each layer" (emphasis added). Final Official Action at page 6, ll. 4-6. Appellant assumes that the Office is here referring to the heat treatment disclosed in JP '418 as the "porosity reducing treatment." However, the Office provided no factual basis to support the alleged inherent result.

As discussed above, even assuming that multiple coating layers are applied on a substrate, and also that each applied layer is subjected to the "porosity reducing treatment" disclosed by JP '418, the Office has provided no factual basis to support the position that the resulting porosity of this coating would necessarily be evenly

distributed. In fact, based on the comparative test results disclosed by JP '418 itself, Appellant submits that one skilled in the art would expect that any porosity remaining in the final multi-layer coating after performing multiple porosity-elimination heating steps would not be evenly distributed in the coating because each layer of this multi-layer structure would be subjected to the JP '418 heat treatment (and thus to pore elimination) for a different length of time than the other layers of the coating, and different heating times produce different amounts of porosity reduction.

Thus, the applied references do not support the alleged *prima facie* case of obviousness of claim 5 for these additional reasons. Therefore, the Board is respectfully requested to reverse the rejection of claim 5.

3. Claim 7

Claim 7 depends from claim 1 and recites that the resulting piston ring coating comprises open pores (23). Figure 4 shows a coating structure including open pores formed between particles 21 of the coating layer 24. Specification at page 10, ll. 19-23. As shown, the open pores pass through the coating to the piston ring surface 22. The open pores are desirable in the claimed multi-layer coating because they can function as a buffer for lubricating substances to provide a lubricant effect on the piston ring during use and thereby reduce friction between the piston ring and a surface.

As shown in Figure 2, the coating material will melt if excessive heat is applied to the coating. Melting of the coating material will result in significantly decreased porosity and closed pores (i.e., pores that are not linked to an external surface), instead of open pores, in the coating. Specification at page 10, l. 32 to page 11, l. 5. Closed pores are generally unable to provide any lubricating effect

and also provide insufficient ductility for the operating conditions to which the piston ring is exposed. Specification at page 11, ll. 6-10. It should be noted that JP '418 discloses that the heat treatment can be performed at the melting temperature of the coating material. *See* the Abstract.

Appellant submits that the Office has not established a factual basis to support the position that a multi-layer coating having an open pore structure would be produced by performing the process disclosed in Ogden or JP '418 for each layer of a multi-layer coating, especially because these references both disclose processes that are designed to eliminate undesirable porosity, not to produce a coating having a certain pore structure. Thus, the applied references do not support the alleged *prima facie* case of obviousness of claim 7 for these additional reasons. Therefore, the Board is respectfully requested to reverse the rejection of claim 7.

4. Claim 11

Claim 11 depends from claim 1 and recites that the heat treatment results in necks (23) in contact points between particles (21) in at least the coating. Figure 3 shows a coating with multiple layers 24. Figure 4 shows contact point necks 23 formed between particles 21 of a coating layer (24) of the Figure 3 coating formed on the piston ring surface 22. These necks provide additional strength to the coating, and are developed by heating the coating material to a temperature below its melting point. Specification at page 10, ll. 19-31. In addition, the necks form within and between adjacent ones of the multiple layers of the coating during the heating, which provides excellent ductility and wear resistance. Specification at page 11, ll. 13-17.

The Office has not established a factual basis to support the position that a multi-layer coating comprising necks in contact points between particles in at least

the coating would be produced by performing the process disclosed in either of Ogden or JP '418, because these references disclose processes designed to eliminate undesirable porosity. Thus, the applied references do not support the alleged *prima facie* case of obviousness of claim 11 for these additional reasons. Therefore, the Board is respectfully requested to reverse the rejection of claim 11.

C. Rejection Under 35 U.S.C. § 103(a) Over U.S. Patent No. 4,024,617 to McCormick in View of U.S. Patent No. 3,066,042 to Ogden, JP 200-017418 and U.S. Patent No. 3,617,349 to Prasse, and Further in View of U.S. Patent No. 5,713,129 to Rastegar et al.

1. Claim 2

Claim 2 depends from claim 1 and recites that "said piston ring (1) is moved relatively to a thermal spray device (3) and a heat treatment device (5) while applying said coating material (4) and heat treatment to said piston ring (1)." *See* Figure 1 and specification at page 8, l. 10 to page 9, l. 8. As described in the specification by the claimed method, the coating material can be applied and then instantly subjected to heat treatment for a short period of time to effect diffusion of the coating material into the underlying surface.

At the least, none of the references applied in the rejection discloses moving a part relative to a heat treatment device while applying a heat treatment to the part, much less to a piston ring during application of a multi-layer coating.

McCormick discloses heating a stack 17 of piston rings 15 with a heating coil 11. The stack of rings is preferably positioned in contact with, or in close proximity to, the inner surfaces 19 of the turns 11a of the heating coil 11. Figure 1; col. 3, ll. 7-47. The stack 17 of piston rings 15 can also be arranged with respect to cooling means 20 to cool the ring inner surfaces 21. Preferably, there is close contact between the opposed surfaces of the cooling wall 22 and the inner surfaces 21 of the

stack 17. Figure 2; col. 3, ll. 48-58. McCormick does not disclose or suggest moving the piston rings during coating or heating.

Ogden and JP '418 both disclose using prolonged heat treatment steps and, at the least, do not disclose moving the parts during the application of heating.

Rastegar discloses a method of manufacturing a coated piston ring using a high-velocity, oxygen fuel spray technique. *See* the Abstract. Rastegar does not disclose a porous multi-layer coating on any substrate. Rastegar also does not suggest moving a heat treatment device while applying a heat treatment to a substrate, much less to a piston ring during application of a multi-layer coating.

Thus, in the absence of any teaching of moving a heat treatment device while applying a heat treatment to a substrate, the Office has not provided an articulated reasoning with factual underpinnings why one skilled in the art would have been led to modify McCormick's single layer coating method, which does not move the stack of rings during heating, to move the rings relative to a thermal spray device and a heat treatment device while applying a coating material and heat treatment to a piston ring in a multi-layer coating process.

Moreover, Ogden and JP '418 both disclose performing heat treatments for extended periods of time (to eliminate porosity). None of the applied references suggests that the claimed multi-layer coating having the recited porosity, and which provides strong bonding to the substrate and between individual coating layers, can be formed using the process steps recited in claim 2.

Thus, the applied references do not support the alleged *prima facie* case of obviousness of claim 2 for at least these reasons. Therefore, the Board is respectfully requested to reverse the rejection of these claims.

2. Claims 3 and 26

Claim 3, which depends from claim 1, recites that "said piston ring (1) is rotated about its axis, in relation to a thermal spray device (3) and a heat treatment device (5), while continuously applying said coating material (4) and heat treatment."

As discussed above, the Office has not articulated a reason with factual underpinnings why one skilled in the art would have been led to modify McCormick's single layer coating method, which does not move the stack of rings during heating, to move the rings relative to a thermal spray device and a heat treatment device while applying a coating material and heat treatment to a piston ring in a multi-layer coating process, much less while continuously applying a coating material and heat treatment to a piston ring in a multi-layer coating process

Moreover, Ogden and JP '418 both disclose performing heat treatments for extended periods of time. None of the applied references suggests that the claimed multi-layer coating having the recited porosity, and which provides strong bonding to the substrate and between individual coating layers, can be formed using the process steps recited in claims 3 and 26.

Thus, the applied references do not support the alleged *prima facie* case of obviousness of claims 3 and 26 for at least these reasons. Therefore, the Board is respectfully requested to reverse the rejection of these claims.

3. Claim 10

Claim 10 depends from claim 1. Rastegar also does not cure the above-discussed deficiencies of the other applied references in regard to the method recited in claim 1.

Thus, the applied references do not support the alleged *prima facie* case of obviousness of claim 10. Therefore, the Board is respectfully requested to reverse the rejection of this claim.

4. Claims 27 and 28

Claims 27 and 28 depend from claims 2 and 3, respectively, and recite that the heat treatment of the piston ring (1) is provided by induction.

Although McCormick discloses the use of an induction heating step to effect a bond between the single-layer coating and the metal substrate, the induction heating apparatus 10 disclosed in McCormick is arranged in close proximity to the stack of piston rings and the piston rings are not moved relative the induction coils 11. The Ogden and JP '418 heat treatment processes do not use induction heating, but involve lengthy heating periods and temperatures designed to eliminate porosity in single and multi-layer coatings, respectively. Rastegar also does not disclose the use of induction heating.

The Office has failed to articulate a reason with rational underpinnings to further modify McCormick's coating process to form multiple coating layers on a piston ring and to heat treat each successively-formed layer by induction heating, to produce the claimed porous, multi-layer coating, while moving the piston ring relative to a thermal spray device and a heat treatment device during the coating process. The Office has also failed to establish that such modification of McCormick's process would be reasonably expected to result in the claimed porous, multi-layer coating.

Thus, the applied references do not support the alleged *prima facie* case of obviousness of claims 27 and 28 for at least these reasons. Therefore, the Board is respectfully requested to reverse the rejection of these claims.

VIII. Claims Appendix

See the attached Claims Appendix for a copy of the claims involved in the appeal.

IX. Evidence Appendix

See the attached Evidence Appendix for copies of evidence relied upon by Appellant.

X. Related Proceedings Appendix

See the attached Related Proceedings Appendix for copies of decisions identified in Section II, supra.

Respectfully submitted,

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Date July 26, 2007

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VIII. CLAIMS APPENDIX

The Appealed Claims

1. (Previously Presented) A method of applying a wear resistant coating material to a surface (22) of a piston ring (1), said method comprising the steps of:

applying said coating material by a thermal spray process,

heat treating said coating material at an elevated temperature and for a time effective to at least partially diffuse said coating material into the underlying surface, by exposing said material to heating temperature below the melting point of the coating material, and

applying additional coating material layers (24) subject to successive heat treatments of each said applied coating material layer (24) in order to lay down on said piston ring surface (22) a plurality of layers (24) of same said coating material, wherein said resulting piston ring coating including the plurality of applied layers (24) has a porosity of between 1 to 15 vol%.

2. (Original) A method according to claim 1, wherein said piston ring (1) is moved relatively to a thermal spray device (3) and a heat treatment device (5) while applying said coating material (4) and heat treatment to said piston ring (1).

3. (Previously Presented) A method according to claim 1, wherein said piston ring (1) is rotated about its axis, in relation to a thermal spray device (3) and a heat treatment device (5), while continuously applying said coating material (4) and heat treatment.

4. (Previously Presented) A method according to claim 1, wherein said heat treatment of said piston ring (1) is provided by induction.

5. (Previously Presented) A method according to claim 1, wherein said resulting piston ring coating has an evenly distributed porosity.

6. (Cancelled).

7. (Previously Presented) A method according to claim 1, wherein said resulting piston ring coating comprises open pores (23).

8. (Previously Presented) A method according to claim 1, wherein each of said coating material layers (24) typically has a thickness of between 0.005 to 0.4 mm.

9. (Previously Presented) A method according to claim 1, wherein said coating material is of pulverulent type when fed to said thermal spray process.

10. (Previously Presented) A method according to claim 1, wherein said coating material has a wire-like form when fed to said thermal spray process.

11. (Previously Presented) A method according to claim 1, wherein said heat treatment results in necks (23) in contact points between particles (21) in at least said coating.

12. (Previously Presented) A method according to claim 1, wherein said coating material comprises a metallic compound selected from the group consisting of Cr_2O_3 and Al_2O_3.

13. (Previously Presented) A method according to claim 1, wherein said coating material is a cermet.

14-25. (Cancelled)

26. (Previously Presented) A method according to claim 2, wherein said piston ring (1) is rotated about its axis, in relation to a thermal spray device (3) and a heat treatment device (5), while continuously applying said coating material (4) and heat treatment.

27. (Previously Presented) A method according to claim 2, wherein said heat treatment of said piston ring (1) is provided by induction.

28. (Previously Presented) A method according to claim 3, wherein said heat treatment of said piston ring (1) is provided by induction.

29-30. (Cancelled)

IX. EVIDENCE APPENDIX

None.

X. RELATED PROCEEDINGS APPENDIX

None.